DOCUMENT RESUME

ED 363 332 IR 016 451

AUTHOR Kerns, H. Dan; And Others
TITLE Effective Engineering Presentations through Teaching Visual Literacy Skills.
PUB DATE 93
NOTE 12p.; In: Art, Science & Visual Literacy: Selected Readings from the Annual Conference of the International Visual Literacy Association (24th, Pittsburgh, PA, September 30-October 4, 1992); see IR 016 399.
PUB TYPE Reports - Descriptive (141) -- Speeches/Conference Papers (150)

EDRS PRICE MF01 Plus Postage. PC Not Available from EDRS.
DESCRIPTORS Educational Technology; *Engineering Education; Higher Education; *Speech Skills; Teacher Role; Undergraduate Students; *Visual Aids; Visualization; *Visual Literacy
IDENTIFIERS *Presentation Mode

ABSTRACT

This paper describes a faculty resource team in the Bradley University (Illinois) Department of Industrial Engineering that works with student project teams in an effort to improve their visualization and oral presentation skills. Students use state of the art technology to develop and display their visuals. In addition to technology, students are taught visual thinking and visual literacy. Topics addressed include: (1) end results, i.e., what knowledge students should receive from the course; (2) diagnostic tools, including flowcharting, Pareto analysis, cause and effect diagrams, and matrix analysis; (3) application of skills through student participation; (4) practicing the presentation skills; (5) dry run and client presentation; (6) evaluation; and (7) future plans. (Contains 8 references.) (SLD)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED 363 332

Effective Engineering Presentations Through Teaching Visual Literacy Skills

by
H. Dan Kerns, Nial L. Johnson
Joseph T. Emanuel, and Kenneth A. Worthington

OVERVIEW

Since 1967, Bradley University's Department of Industrial Engineering has used the community as a problem solving laboratory for its students. Student teams are assigned to local organizations to help those organizations solve real operational and design problems. Although this effort has made students (and faculty) more aware of the types of problems that industries face and has improved the students' ability to become problem solvers, some obvious problems have continued to be areas of concern for the faculty. Two of those areas are the ability of students to clearly identify and analyze problems and the ability to clearly communicate the recommended solutions to these problems. Both of these problems have been tackled by a faculty team approach using faculty from Industrial Engineering, Communication and professional staff from Audio Visual Services.

The faculty resource team works with student project teams in an effort to improve their visualization and oral presentation skills. The student project teams are required to give several formal presentations both on campus and at the client's firm. Students utilize state-of-the-art technology to develop and display their visuals for the presentations. Color Macintosh computers and advanced presentation software packages are used in the creation of the visuals which are either imaged and used as projected traditional 35mm slides or are projected by a color data display panel. Incorporating this technology requires additional instruction time for students with the benefits outweighing the resources required. In addition to technology, students are taught visual thinking and visual literacy throughout the process.

The team approach to teaching students visual literacy skills has been successful. Evaluations of this approach have shown:

1. Students learn how to communicate more effectively through the use of visual,
2. A greater acceptance by clients of the proposed solutions presented, and
3. An increase in the implementation of the solutions by clients.

INTRODUCTION

Engineers are trained in applying engineering tools to solve technical problems. However, in today's competitive environment, successful communication of the solution is crit-

"PERMISSION TO REPRODUCE THIS MATERIAL IN **OTHER THAN PAPER COPY** HAS BEEN GRANTED BY

Alice D. Walker

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

☐ This document has been reproduced as received from the person or organization originating it.
☐ Minor changes have been made to improve reproduction quality.
• Points of view or opinions stated in this document do not necessarily represent official OERI position or policy.

120164S1

ical to the implementation of the solution and the success of the project. This paper presents a methodology for improving the visual communication aspect of presentations.

While this approach is currently being used at Bradley University in the Industrial Engineering senior capstone design course, this technique can be applied to many different environments. The fundamentals of this successful program can be used in teaching, team projects and other presentations. We hope to aid others who might want to adopt our method by providing a framework for how the process occurs. Our examples illustrate the tools students use in problem solving and organizing the material visually. The content of these examples (flow charts, cause-effect diagrams, etc.) is the process which we follow.

This paper is divided into various sections loosely based on the faculty team member's discipline. Many concepts crossover "traditional discipline boundaries" and become blended. No longer will you find the Communication faculty team member just talking about effective presentation skills. Additionally, one could find concepts of Visual Communication Theory being informally taught and demonstrated by Industrial Engineering faculty. The overlap and reinforcement of concepts has occurred over time. As the faculty team evolved through the process they have learned from the other disciplines. The end result of this cross-fertilization is optimizing ways to achieve the goal and objective of teaching students to become visual thinkers, visually literate and to improve their communication skills.

THE END RESULTS

In designing any course, educators ask themselves what knowledge should students receive from the course. One of the objectives of the capstone design course is to ensure demonstrated proficiency in Industrial Engineering skills. The second objective is to ensure that the students grow into visual thinkers and better communicators. To this end, we have developed a unique faculty resource team approach. The authors draw upon the talents of individuals from several disciplines to provide the type of education desired. Faculty from Industrial Engineering oversee the student's progress and provide leadership in the student's efforts in solving a real problem for a client in the Peoria area. Faculty from Communication work with the students in developing their oral communication skills and visualization techniques. Additionally, another faculty member works with the students to develop their presentation aids skills. Throughout the semester the students are challenged to think visually — from start to finish, not just at presentation time.

For example, a student team helped a local hospital implement a new accounting system. The old system required the input from many departments. Information that was contained on many different forms was used by a variety of departments. In solving this problem the students needed to understand how this information flowed from department to department and what information was needed by each department. The student team wrestled with this project — trying to define the real problem. They carried loads and loads of paperwork with them, but had trouble defining what infor-

mation they needed and how they could incorporate it into only a few forms. After a suggestion by the faculty team, reminding them to think visually, the student team had a breakthrough. They developed a chart to determine what information was on each form. They quickly found that 80% of the forms in use by the hospital contained duplicate information that needed to be recopied onto each new form. The breakthrough was "seeing" what information was contained on the forms by visually presenting the information in a summary format. The team developed one form which replaced thirteen forms. This not only saved valuable time for the hospital, but the quality of information received was consistent and accurate.

DIAGNOSTIC TOOLS

The above example is just one of the diagnostic tools (matrix analysis) used by project teams in the engineering design process,also called the scientific method, in solving open-ended client problems. This process consists of seven major components:

- Formulation of the problem
- Analysis of the problem
- Search for alternatives
- Evaluation of alternatives
- Specification of the preferred solution
- Implementation of the solution
- Monitoring and controlling the system

Throughout this process, students use a set of diagnostic tools which allows the students to analyze the problem. Much of the data available from the client is in numerical format. Using diagnostic tools gives students a more visual format for displaying and understanding data. The diagnostic tools are especially useful for tracking the problem symptoms back to the root causes. Without establishing the correct link between symptoms and causes, an appropriate solution to the problem cannot be found. A sample of diagnostic tools commonly used by the project teams includes:

- *Flowcharting* is the visual representation of people, materials, or information through a system. **See figure 1.** This technique helps students understand the current state of the client's problem. Flowcharting is also useful to show the difference between the current state and the proposed state.

- *Pareto analysis*, also called the "80/20 rule", rank orders the data according to relative contribution to a problem. The top contributors are identified as the "vital few" contributors. The rest of the contributors are called the "trivial many". Since limited resources (time, money, etc.) are available for solving the problem, concentrating on the vital few will allow the team to make recommendations which will affect a significant chunk of the problem. This technique can be displayed in table form or graphically to illustrate the vital few clearly.

- *Cause and Effect Diagrams*, also called "fishbone" diagrams, illustrate the relationship between symptoms and causes. As teams gather information in the problem analysis phase, they organize the information into a cause and effect diagram. **See figure 2.** The symptom(s) should appear on the right end

FIGURE #1

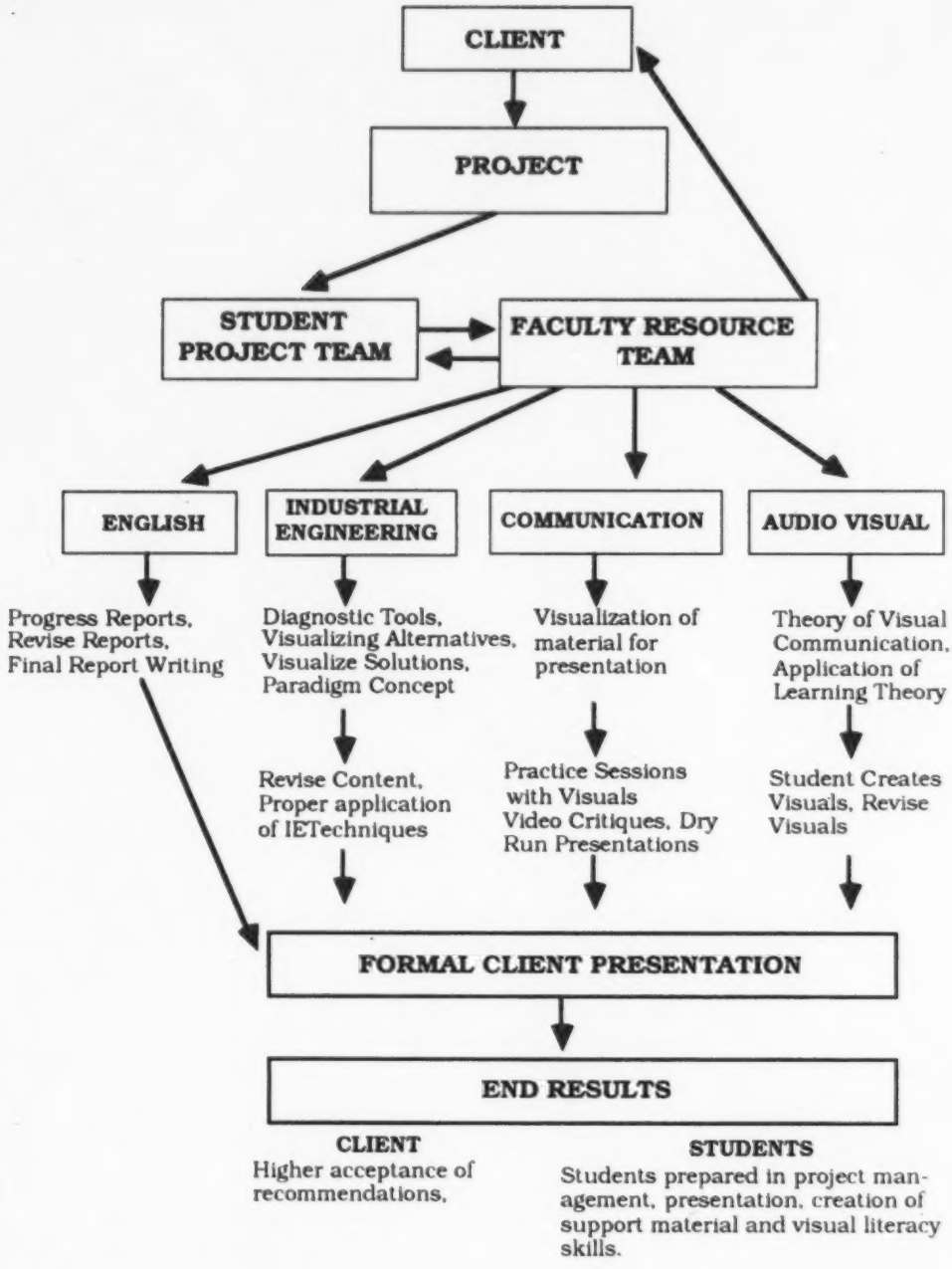

CLIENT
PROJECT
STUDENT PROJECT TEAM
FACULTY RESOURCE TEAM
ENGLISH
INDUSTRIAL ENGINEERING
COMMUNICATION
AUDIO VISUAL
Progress Reports, Revise Reports, Final Report Writing
Diagnostic Tools, Visualizing Alternatives, Visualize Solutions, Paradigm Concept
Visualization of material for presentation
Theory of Visual Communication, Application of Learning Theory
Revise Content, Proper application of IETechniques
Practice Sessions with Visuals Video Critiques, Dry Run Presentations
Student Creates Visuals, Revise Visuals
FORMAL CLIENT PRESENTATION
END RESULTS
CLIENT
Higher acceptance of recommendations.
STUDENTS
Students prepared in project management, presentation, creation of support material and visual literacy skills.

FIGURE #2

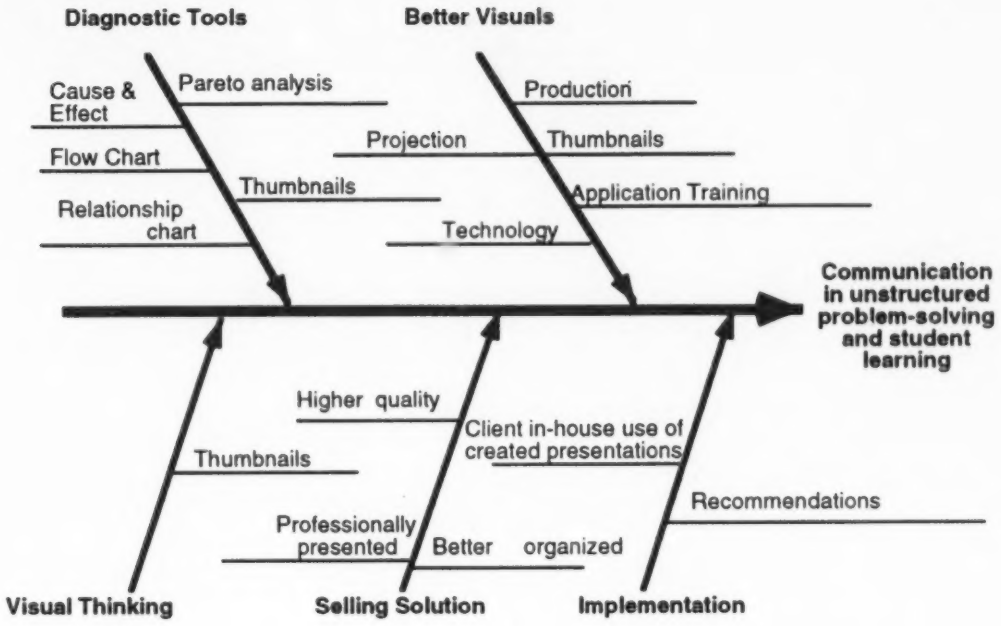
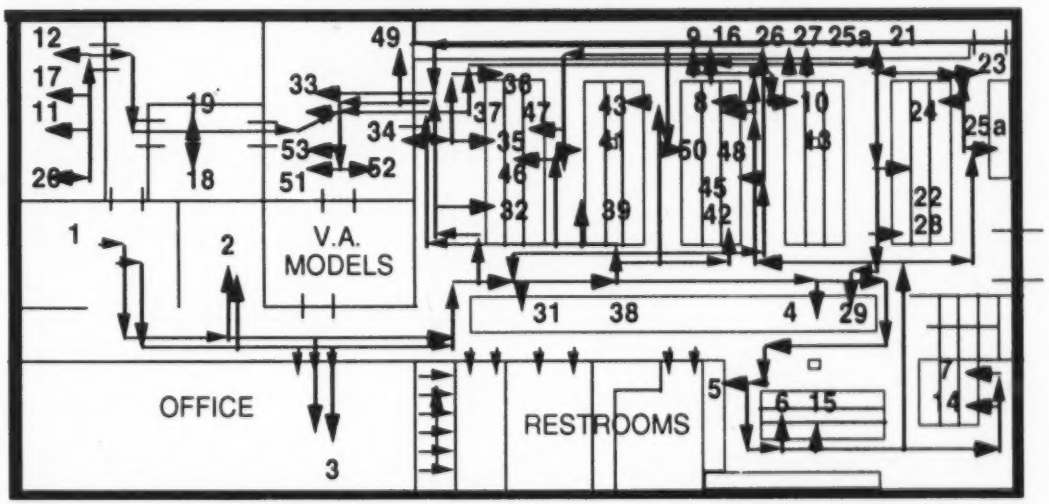


FIGURE #3

CURRENT LAYOUT



(head of the fish) with the suspected major contributing causes forming the main branches off of the spine. Brainstorming can be used initially to develop the skeleton. The sub-items under each main branch will be filled in as more information is collected. Brainstorming by the team will provide some theoretical causes. Then the team can investigate each theory and fill in the sub-items with facts or discard the main branch as the investigation continues. This tool allows the team to solidify their understanding of the problem within the group and to use the diagram as an aid in problem discussion with the client. Additionally, this single visual tool discourages students from solving individual problems in isolation and encourages them to take a systems approach to solving the problem.

- *Matrix analysis* is a combination of Pareto analysis and a relationship chart which is used to identify multiple causes of errors. This is the tool used in the hospital example.

All of these diagnostic tools allow the students to visualize the problem in order to establish the relationship between symptoms and causes. This analysis is critical to providing an appropriate solution for the client.

The following examples have been included to further illustrate the importance of diagnostic tools. A student project team worked with a local utility to develop a model to be used to establish guidelines for purchasing natural gas. Multiple suppliers, multiple storage fields and multiple transportation pipelines were available. Even the department charged with making these decisions had difficulty understanding the decision options that were available.

One of the student team members developed a schematic "picture" of the allocation process so the students could make sure they had defined all the parameters of the system. Upon showing their picture to the the president of the company, he remarked that this was the first time he had actually understood the problem the company was trying to solve. In tackling problems that involve the flow of material (or information), a layout of the facility drawn to scale, a series of arrows on the layout showing flow **(See figure 3)** and some type of pictorial representation showing the steps in the process helps groups involved in the problem solving process identify and understand the parameters of the problem and what steps might be taken to solve the problem. Until the student teams make a commitment to put this information on paper, they tend to talk "about" the problems rather than being able to identify exactly what the problems really are.

APPLICATION OF SKILLS

As with any educational endeavor, simply telling students how to do something isn't as effective as demonstrating and requiring student participation. The faculty team demonstrates visual thinking skills throughout the semester in the way they teach as well as requiring participation in skills taught. Students have the use of a color Macintosh lab with the needed software to create quality presentation slides. A faculty member from Communication

teaches theories of visual communication and demonstrates those skills.

Student project teams are exposed to formalized demonstrations of visual material production and utilization twice during the semester. An administrative staff member serving a dual role as AV Services Coordinator and instructor in the Communication program provides group instruction in the use of Microsoft Powerpoint® utilizing a color LCD plate, wireless remote control, and the desired computing platform. Students are instructed on the theory of visual communication which covers basic information concerning legibility, type size, color, background material, and designing for the medium. In addition to application specific instruction, the value of producing high quality, aesthetic visuals which are very legible is reinforced. Students are expected to use this newly acquired skill as early as the first assignment in which they are asked to turn in one visual produced using this application. Remaining assignments for the duration of the semester provide the opportunity to refine visuals during regularly held report sessions. Students were provided with limited color palettes and backgrounds in order to reduce the amount of time spent "playing around with choices".

The second meeting (utilizing different presentation mediums) provided the project teams with a Q&A opportunity from the first meeting and ensuing assignments — Why doesn't this work? Can I do that? How do you achieve this? Discussions concerning the value of using visual aids in retention, the various visual aids available and their impact on group size. Additionally, strengths and weaknesses of each are discussed as well as cost, production constraints and review of production guidelines. Samples — not only what can be done, but more importantly, what students have produced over the past five years are demonstrated. Examples from both ends of the scale are used — what has been successful; what has come up short - why for each.

After the basics skills are covered, the project teams are also provided handouts from the office of Audio Visual Services which provides an introduction to the variety of support services available. As a comprehensive media service offering consultation, production and equipment support this further strengthened the base for student productions. Project teams are able to set independent meetings with the Coordinator (a member of the faculty resource team) to discuss ideas, concepts, and in general refine visual support materials. These meetings provided the opportunity to tailor presentation visuals and discuss information visualization.

Historically, the services provided by the Audio Visuals Services were those of an in-house production department. As the faculty team approach and technology progressed and evolved, services changed from that of a production service to support and instructional services. Early on, services required professional and supervised student staff from Audio Visual's photography, typesetting, and graphic design units to produce student visual support materials. Professional staff was needed due to the complexity and skill level required to make visuals. Although manageable at first, "spreading the word" to other departments created a landslide of senior projects at the

end of each semester which created bottlenecks in all productions areas. Ongoing review and evaluation by the Faculty Resource Team led to the University's purchase of a color Mac and presentation software and a shift to student produced visuals with appropriate instruction.

Student produced presentations were stored on computer files and were processed by a "customized" service bureau developed by AV. Students bring the visuals they created on disc to AV to be imaged into traditional 35mm slides. Before the images were processed, the electronic files are critiqued for legibility, appropriateness, simplicity and effective design. AV professionals often consulted one another and used their experience to discuss ways in which to enhance the visual aspect of the presentation which might have eluded the student skill. Production bottlenecks were reduced due to the redirected production and turn time was enhanced for all. AV imaging however, was scheduled to achieve the maximum number of film rolls per day which provided very little margin for error, fixes, or additions. Dry runs or final rehearsals generally resulted in minor fixes or the creation of just one or two more visuals. This of course was usually a day or so before the final presentation to the the project client — CEO, president, VP, manager.

Today, this process has been further refined through the acquisition of technology. Where students still produce their own materials and AV images them, the dry run and rehearsal process has benefitted from LCD panels. LCDs have relaxed deadlines, enhanced the ability to make last minute error corrections, allowed student groups the opportunity to sort and easily restructure the flow of their visuals, and provided the service bureau flexibility in scheduling high resolution imaging. Although the project team believes that film-based visual aids are of higher quality and impact, student groups who have used LCDs as their final presentation medium have aroused the curiosity of client groups in this technology.

PRACTICING THE PRESENTATION SKILLS

The next area of demonstration is in the coaching sessions which are devoted to examining the material the project team wishes to present to the client. The project group is required to have a full sentence/full content outline prepared for this meeting. The outline is examined to judge what material can be deleted and what needs to be added in order that understanding and comprehension can take place on the part of the client. Once a completed outline is finished, the project team is encouraged to brainstorm to relate the material at hand to the audience visually. This is important and necessary when the material at hand is technical or complex. This session falls after the project teams' meeting with the Communication faculty who have discussed with them the basics of visuals. Many questions are raised by the communication faculty member:

- Can pictures inside the plant help illustrate the point that you're trying to make?
- How are you going to interact with your material?
- Does your client have a preferred corporate look to the visuals?

- How can you spruce up your visuals for a more effective professional look?

- What "hooks" can you provide in your visuals to reinvolve those who may have tuned out during a portion of your presentation?

This session generally proves to be very useful. Many rough, thumbnail sketched visuals are prepared. To aid in the design of the visuals, templates for slides are available so the project team can better understand the space constraints of the medium. Many of the dividends of this session pay off with the next visit to the client's firm. The project team begins to look for those things which could help them tell their presentation visually.

Over the next three to five weeks the communication faculty member holds a series of coaching sessions with the project teams. The majority of the sessions falling closer to the dry run and client presentation. An IE faculty member attends these sessions to help insure accuracy of the technical content. The sessions are videotaped and immediately reviewed and oral critiques follow. The group as a whole benefits from reviewing the videotape. They get to see first hand not only their own portion of the oral presentation but also that of their peers. This helps reinforce the positive aspects while also underlining the less than desired behavior. At this point the bulk of the research has been conducted, the written report is well underway and the presentation is taking shape. The remaining sessions are generally spent fine-tuning the delivery aspects of the speakers.

DRY RUN AND CLIENT PRESENTATION

As the semester draws to a close, all the aspects of the project come together. Students are required to make a formal presentation of their semester's work to an on-campus group. This dry run presentation is a dress rehearsal for the student's client presentation. All aspects of the presentation are in there final form, although some changes are identified as a result of audience feedback.

The client presentation is a formal presentation, usually held in the board room. The CEO, president, VP, manager and steering committee are generally in attendance. One of the points the Communication faculty member stresses early on is the per minute dollar value of personnel assembled for the final presentation. The top administrators for the organization are assembled. The students must be able to present the information in an organized fashion and have the client assimilate the information quickly and accurately.

Good effective visuals are a must. An example of this is one student project team who worked on a layout project for a dental appliances design and manufacturing firm. The current layout had material unnecessarily traveling throughout the firm and backtracking in several locales. To illustrate the extent of the problem, the group calculated the distance travelled by their employees — 3400 miles a year while carrying four cases and then used that information to design a visual representing that distance from LA to New York. This was very effective in captivating the attention of the client. **See figure 4.**

FIGURE #4

EVALUATION

One of the measurements of effectiveness is whether the students become visual learners. We have several evaluation procedures to gauge this.

One obvious method is gauging the success of their semester long project. The students complete a comprehensive written and oral evaluation. Factors evaluated include:

- themselves
- team members
- faculty input
- client input
- quality of problem
- quality of solution.

The faculty evaluates both the students and their own performance, which results in constant modifications and improvements in the process.

Another measure of performance is delayed feedback from the students. After graduation students often call, write or stop back to express their gratitude for the experience. They are often well ahead of their peers at the firms where they are employed. The former students offer thoughtful reflections on the process and offer suggestions for future project teams.

An additional measure of effectiveness of the process is greater implementation of recommendations by the client. This acceptance of the students' proposals couldn't have occurred unless the students were able to define the problem, present the information, offer recommendations in a clear and concise fashion and "sell" the solution. We firmly believe that the ability of the students to examine the problem pictorially and visually present alternatives and solutions results in the greater acceptance by the client. Often the client asks for a copy of the presentation visuals to use to present the information internally. Additionally, we have had clients ask for seminars on creating visuals and presentations.

EPILOG

In the end, we produce visually literate students, equipped with the necessary engineering and communication skills to be highly competitive in the work force. In a minimal sense, we have exposed the client to visual literacy skills.

Since 1967 the process has evolved greatly. The evolution is ongoing — the Engineering capstone design course is in a constant state of flux, changing with technology and approaches. Fifteen years ago, we looked at the student groups and thought we'd reached the peak — they were really good. The process has changed numerous times since then and will continue to change and so will we. Here are our predictions for the future of our project.

FUTURE

The faculty team's projections for the future of the Industrial Engineering capstone design course includes the following changes which correspond to advancing technology which will again find their way into this process.

Multimedia on the desktop will provide the opportunity to blend still and motion video, animation, and static images into powerful client presentations. Today's projection devices are already capable of providing for this mix. With this change however, it is perceived that students will once again become more dependent on production professionals for the bulk of their programs.

Enhanced hardware platforms that incoporate leading edge technology such as photo CDs and full motion video to provide digitized visual support and desktop videoconferencing to provide convenient means of communication will allow students additional resources for accessing and producing presentations.

Growth of computer networking and problem-solving software such as artificial intelligence and total quality management which will allow the problem solving process to be shared by more users which may change how information is shared for team problem solving processes.

Improved simulation software which will allow processes to be modeled more accurately and displayed more accurately. Viewing a simulation of the current process in a team setting will stimulate team members to generate more ideas for investigation and ultimately provide a higher quality solution at a lower cost.

FURTHER REFERENCE

Emanuel, J. T. & Worthington, K. (1991, March) Evaluation of Individual Performance in a Team-oriented Capstone Design Course. *ASEE Gulf-Southwest Section Annual Meeting Proceedings.*

Emanuel, J. T. & Worthington, K. (1987, October) Senior Design Project: Twenty Years and Still Learning. *ASEE 1987 Frontiers in Education Conference Proceedings.*

Emanuel J. T. & Worthington, K. (1990, March) Capstone Design: Integrating Resources for Today's Students and Tomorrow's Engineers. *ASEE Gulf-Southwest Section Annual Meeting Proceedings.*

Kerns, H. D., Emanuel, J. T., & Worthington, K.(1991, October) Managing Communication Through Technology in Senior Design Projects. *ASEE North-Midwest Section Meetng Proceedings.*

Kerns, H. D., Dusenbery, P., Emanuel, J. T. & Worthington, K. (1990, October) Improving Engineering Communication Through a Team Approach. *Institute of Industrial Engineers Integrated Systems Conference Proceedings.*

Worthington, K. (1990, June) Stimu-lating Discussion of Engineering Economy UsingDisplay Panel Technology. *ASEE Annual Conference Proceedings.*

Worthington, K. (1989, October) Classroom Innovation Using Case Studies and Computer Display Panel Technology to Stimulate Discussion of Engineering Principles. *ASEE 1989 Frontiers in Engineering Education Conference Proceedings.*

Worthington, K. (1987, October) Breaking the Mold-Engineering Students Communicating with Themselves and Others. *ASEE 1987 Frontiers in Education Conference Proceedings.*